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ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is included. (AG)

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FINAL REPORT

TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

COPY HOLDER (clerical) 209.588
PROOFREADER (print. & pub.) 209.688

S-108

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EDUCATION & WELFARE
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U. S. Employment Service in
Cooperation with
Pennsylvania and Tennessee State Employment Services

U. S. DEPARTMENT OF LABOR

Washington . :, D.C.
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Spring 1956

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR COPY HOLDER 209.588 PROOFREADER 209.688

S-108

Summary

The General Aptitude Test Battery, B-1002A, was administered to two samples of proofroom workers. The State in which the sample was obtained, the occupation(s) covered, the number included in the final experimental sample and the type of criterion used for validation purposes are shown below for each sample.

State	D.O.T. Title	N	Criterion
Pennsylvania	Proofreader 209.688	57	Work sample
Tennessee	Copy Holder 209.588	48	Descriptive Rating Scale
	Proofreader -		

Data for the two samples were analyzed separately and in combination. On the basis of the statistical and qualitative analysis of the data, Aptitudes G-Intelligence, V-Verbal Aptitude, P-Form Perception and Q-Clerical Perception were selected for inclusion in the test norms.

GATB Norms for Copy Holder 209.588, Proofreader 209.688, and -

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Copy Holder 209.588 Proofreader 209.688

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for S-108

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
G	CB-1-H CB-1-I CB-1-J	90	G	Part 3 Part 4 Part 6	85
V	CB-1-J	100	V	Part 4	100
P	CB-1-A CB-1-L	95	P	Part 5 Part 7	95
Q	CB-1-B	100	Q	Part 1	100

Effectiveness of Norms

The data in Table IVC indicate that 21 of the 34 poor workers, or 62 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 62 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 53 of the 66 workers who made qualifying test scores, or 80 percent, were good workers.

TECHNICAL REPORT

I. Problem

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the General Aptitude Test Battery for the occupations of Copy Holder 209.588, Proofreader 209.688 and .

II. Samples

This study is based on two samples of employed workers. The distinction between the Validation Sample and the Cross Validation Sample is an arbitrary one. The test norms were developed on the basis of the results of both samples.

A. Pennsylvania - Validation Sample

The General Aptitude Test Battery, B-1002A, was administered during the period March 19-23, 1956 to 60 Proofreaders 209.688 employed by the Mack Printing Company, Easton, Pensylvania. The tested sample included all of the 73 workers employed on this job who volunteered to be tested. Of the 60 workers tested, three were eliminated from the sample because criterion data could not be collected for them. Thus, the final sample consisted of 57 workers (53 women and 4 men).

Workers were selected for employment on the basis of an interview with the Personnel Manager. The company prefers college graduates and requires at least a high school education for this job. An additional requirement is passing a spelling test given by the company. There are no age requirements.

New workers are given three months of training by the supervisor of the proofroom.

B. Tennessee - Cross Validation Sample

The General Aptitude Test Battery, B-1002A, was administered to 48 female proofroom workers in five establishments in Nashville, Tennessee. The establishments, the numbers tested, and the dates of testing are as follows:

Establishment	Number Tested	Date
Baird-Ward Printing Company	21	April 1953
McQuiddy Printing Company	5	March 1955
Methodist Publishing House	11	April 1955
E. T. Lowe Printing Company	7	October 1953 and July 1955
Baptist Sunday School Board	4	September 1955

The 48 persons tested included all proofroom workers employed at the above establishments at the time of testing.

Table II-A shows the means, standard deviations, and ranges for age, education and experience for the Pennsylvania sample, the Tennessee sample and the Combined Sample. Table II-B shows the Pearson product-moment correlations with each of the two criteria for the Pennsylvania sample and with the criterion for the Tennessee sample.

TABLE II-A

Means (M), Standard Deviations (σ) and Ranges for Age, Education and Experience for the Pennsylvania Sample, the Tennessee Sample and the Combined Sample

Copy Holder .209.588
Proofreader .209.688

	Pennsylvania (N = 57)			Tennessee (N = 48)			Combined (N = 105)		
	M	σ	Range	M	σ	Range	M	σ	Range
Age (years)	30.9	11.6	18-62	38.5	10.2	21-63	34.4	11.6	18-63
Education (years)	12.2	.7	12-16	11.4	1.5	8-16	11.8	1.2	8-16
Experience (months)	85.2	92.8	3-411	71.2	75.2	4-324	78.8	85.5	3-411

TABLE II-B

Pearson Product-Moment Correlations with the Speed (r_1) and Accuracy (r_2) Criteria for the Pennsylvania Sample and with the Criterion (r) for the Tennessee Sample for Age, Education and Experience

Copy Holder 209.588
Proofreader 209.688

	Pennsylvania (N = 57)		Tennessee (N = 48)
	r_1	r_2	r
Age	-.237	-.268*	.134
Education	-.116	-.047	.288*
Experience	-.162	.135	.050

* Significant at the .05 level.

The data in Table II-A indicate that the workers in the Pennsylvania sample tend to be somewhat younger and have more education than the workers in the Tennessee sample. Two of the correlations shown in Table II-B are significant. The negative correlation between criterion 2 (accuracy of proofing) and age for the Pennsylvania sample indicates that there is some tendency for the younger workers to be more accurate proofers. The positive correlation between the criterion (descriptive rating scale) and education for the Tennessee sample indicates that there is some tendency for the better educated workers to receive higher ratings. Neither of these correlations is high, however. The data in Tables II-A and II-B indicate that the two samples are suitable for test development purposes with respect to age, education and experience.

III. Job Descriptions

Job Titles: Copy Holder 209.588
Proofreader 209.688

COPY HOLDER (Tennessee)
Job Summary: Assists Proofreader to correct proof sheets of printed matter. Reads original copy aloud to Proofreader, calling out punctuation marks and spelling out unusual words, proper names and apostrophes. Follows through original copy, word for word, as Proofreader reads proof sheet aloud. Calls attention to any discrepancies between copy and proof. Rechecks second proof after Compositor has made corrections.

Work Performed: Reads orignnal copy aloud: Takes original copy of material to be reproduced and reads aloud to Proofreader who reads silently from proof. Calls out punctuation marks and spells out unusual words, proper names, and apostrophes.

Listens to reading of proof: Reads original copy silently while Proofreader reads proof aloud. Stops Proofreader when original copy does not agree with proof. Observes corrections made by Proofreader to learn proper printers' marks, codes, style and terminology. Sends proof to Compositor for corrections and second proof.

Revises proof: Receives second proof from Compositor. Checks in detail the lines, headings, etc., omitted from original proof. Makes ruler measurements of margins and spacing and otherwise checks to see that proof conforms to specifications. Returns proof to Compositor for final corrections.

PROOFREADER (Pennsylvania and Tennessee)
Job Summary: Reads and corrects proof while Copy Holder reads aloud from original copy. Reads proof aloud, making corrections when discrepancies between the original and proof are pointed out by Copy Holder.

Work Performed: Listens to reading of original copy and makes corrections on proof: Takes proof of printed material and reads silently while Copy Holder reads original copy aloud. Follows reading closely to detect errors in the proof and uses pencil to make notations on the proof to make it coincide with the original. Employs a standard set of markings and techniques used by the printing industry to indicate the exact correction to be made on the proof.

Reads proof copy aloud and makes additional corrections: Reads proof copy aloud while Copy Holder reads original copy silently. Calls out punctuation marks and spells out unusual words, proper names, and apostrophes. Makes corrections on proof when original and proof copies do not agree.

READER, FIRST II (Tennessee)
Job Summary: Reads typescript or proof of type to detect and mark for correction any grammatical, typographical or compositional errors before proof is reviewed by Copy Holder and Proofreader. Checks proof against original copy when in doubt.

Work Performed: Reads proof and makes corrections: Places proof and original copy side by side on reading board and reads proof. Watches for errors in spelling, punctuation, grammatical construction, type size, bad letters, spacing, etc. Checks proof with original if questions arise. Marks errors in the proof using printers' symbols.

NOTE: Proof is first reviewed by Reader, First II and subsequently by Copy Holder and Proofreader who work as a team.

IV. Experimental Battery

All of the tests of the GATB, B-1002A, were administered to each sample.

V. Criteria

A. Pennsylvania - Validation Sample

A work sample consisting of a galley to be proofread was used as the criterion. The galley was made up of printed copy of extracts from representative publications printed by the Mack Printing Company. Twenty minutes were allowed for proofreading the material which contained 53 compositional errors. Since ability to proofread is a function of both speed and accuracy, the completed worksamples were scored separately for these two components. The two criterion measures obtained are as follows:

1. Criterion 1 (Speed): The reading speed for completion of the entire galley in the 20 minutes allowed is 59.3 words per minute. Using this speed as the base, a "percent of words completed" score for each worker was computed by determining the number of words per minute (WPM) read and substituting this value in the following formula:

$$\text{Percent of Words Completed} = \frac{(\text{WPM})\ (100)}{59.3}$$

The mean speed score obtained for the sample was 96.6, the standard deviation of the scores was 20.2, and the range of scores was 51.1 to 143.0.

2. Criterion 2 (Accuracy): A measure of accuracy or a "percentage of errors detected" score for each worker was computed by 1) determining the number of errors not detected in the material completed, 2) determining the number of errors present in this material, and 3) substituting these values in the following formula:

$$\text{Percentage of Errors Detected} = 100\left(1 - \frac{\text{errors not detected}}{\text{errors present}}\right)$$

The mean accuracy score was 71.7, the standard deviation of scores was 8.3, and the range of scores was 49.0 - 87.5.

The correlations between the speed and accuracy scores was .04, indicating that these two criteria are measuring different aspects of work performance. Therefore, these two criteria were not combined into a single composite for the validation analysis. Product-moment correlations with the aptitudes were computed for each criterion separately and the selective efficiency of trial norms was evaluated against a dichotomized multiple hurdle criterion in which a critical score was set on each criterion separately.

B. Tennessee - Cross Validation Sample

Supervisors' ratings were used as the criterion. The ratings were made on a three-item descriptive rating scale covering quantity and accuracy of work performed and versatility of the worker. The items were arrived at in discussion with supervisory personnel long familiar with proofroom and composing room requirements.

Each item on the scale has five alternatives lettered from a to e. A rating of "a" indicates very low performance and was assigned a numerical score of 1; a rating of "e" indicates very high performance and was assigned a numerical score of 5. Ratings of b, c, and d were assigned numerical scores of 2, 3 and 4, respectively. The total score on the scale was the sum of the numerical values corresponding to the letters of the alternatives checked for the three items.

Some of the workers were rated twice and for these workers the criterion score was the sum of the two ratings. For those workers rated only once, the rating was doubled. Thus, the possible range of criterion scores was from 6 to 30.

The actual range of scores was from 6 to 30. The mean was 19.25 and the standard deviation was 5.51.

VI. Statistical and Qualitative Analysis

The workers in the Pennsylvania and Tennessee samples were performing the same or closely related job duties. In addition, the data in Tables II-A and II-B indicate that the two samples are similar with respect to age, education and experience. When more than one sample of workers performing the same or closely related jobs are available and the data are comparable, it is desirable to combine the samples in the analysis when statistically feasible because of the greater stability of results obtained on large samples. Therefore, the data were analyzed both separately and in combination where such combination could be justified statistically.

Table III-A shows the means and standard deviations of the aptitudes of the GATB for the two samples separately and for the combined sample. The means and standard deviations are comparable to general working population norms with a mean of 100 and a standard deviation of 20 for each aptitude.

Table III-B shows the correlations between the criteria and the aptitudes of the GATB for the two samples.

TABLE III-A

Means (M) and Standard Deviations (σ) of the Aptitudes of the GATB for Each Sample Separately and for the Combined Sample
Copy Holder 209.588
Proofreader 209.688

Aptitudes	Pennsylvania (N = 57)		Tennessee (N = 48)		Combined (N = 105)	
	M	σ	M	σ	M	σ
G-Intelligence	114.2	15.0	101.5	15.2	108.4	16.3
V-Verbal Aptitude	117.2	14.3	105.3	14.5	111.7	15.5
N-Numerical Aptitude	115.7	15.1	97.4	15.5	107.3	17.8
S-Spatial Aptitude	100.9	18.1	97.8	15.8	99.5	17.1
P-Form Perception	116.2	20.0	99.1	15.2	108.4	19.9
Q-Clerical Perception	132.4	17.9	109.7	14.1	122.0	19.8
K-Motor Coordination	121.8	15.0	109.9	15.8	116.4	17.5
F-Finger Dexterity	102.5	19.6	96.8	18.6	99.9	19.3
M-Manual Dexterity	99.5	18.2	94.5	19.4	97.2	18.9

TABLE III-B

Pearson Product-Moment Correlations with the Speed (r_1) and Accuracy (r_2) Criteria for the Pennsylvania Sample and with the Criterion (r) for the Tennessee Sample for the Aptitudes of the GATB

Copy Holder 209.588
Proofreader 209.688

Aptitudes	Pennsylvania (N = 57)		Tennessee (N = 48)
	r_1	r_2	r
G-Intelligence	.338*	.053	.411**
V-Verbal Aptitude	.289*	-.105	.480**
N-Numerical Aptitude	.414**	.156	.263
S-Spatial Aptitude	.180	.102	.218
P-Form Perception	.258	.324*	.060
Q-Clerical Perception	.488**	.071	.350*
K-Motor Coordination	.198	.136	-.064
F-Finger Dexterity	.169	.152	.042
M-Manual Dexterity	.155	-.006	.022

* Significant at the .05 level
** Significant at the .01 level

The statistical results were interpreted in the light of the qualitative analysis of the work performed by proofroom workers. The following aptitudes appear important from a qualitative analysis of the jobs of Copy Holder 1-04.01, Proofreader 1-10.07 and Reader, First II 1-10.07:

Intelligence (G) - required to learn rules of grammar, punctuation, etc., and to learn printers' marks, codes, style and terminology.

Verbal Aptitude (V) - required to learn rules of grammar, punctuation, etc., and to understand verbal material when reading and listening to reading of proof.

Form Perception (P) - required to perceive pertinent detail in proof such as blurs, misshapen letters and margins, and to make visual discriminations in checking proof against original copy.

Clerical Perception (Q) - required to perceive pertinent detail in proof such as recognizing typographical errors, and to recognize differences between proof and original copy.

Motor Coordination (K) and Finger Dexterity (F) - required to coordinate eyes and fingers in manipulating papers and making proofreaders' marks.

A comparison of the mean aptitude scores shown in Table III-A shows that, in general, the mean scores for the Pennsylvania sample are higher than those for the Tennessee sample. Although the differences between scores are fairly large, the profiles of mean scores for the two samples tend to be parallel. For the combined sample the highest mean scores, in descending order of magnitude, were obtained for Aptitudes Q, K and V, respectively.

The data in Table III-B show that Aptitudes G, V and Q have significant correlations with the speed criterion for the Pennsylvania sample and with the criterion for the Tennessee sample; Aptitude N has a significant correlation with the speed criterion for the Pennsylvania sample; and Aptitude P has a significant correlation with the accuracy criterion for the Pennsylvania sample.

Based on the qualitative and quantitative evidence cited above, Aptitudes G, V, P, Q and K warranted further consideration for inclusion in the test norms. Aptitudes V and Q were selected for consideration because they appeared important from the qualitative analysis of the work performed, had high mean scores, and significant correlations with the speed criterion for the Pennsylvania sample and with the criterion for the Tennessee sample. Aptitude G was selected because this aptitude appeared important from the qualitative analysis, had a significant correlation with the speed criterion for the Pennsylvania sample and with the criterion for the Tennessee sample. Aptitude P was selected because this aptitude appeared important from the qualitative analysis and had a significant correlation with the accuracy criterion for the Pennsylvania sample. Aptitude K was selected because this aptitude appeared important from the qualitative analysis and had a high mean score. Although Aptitude N had a significant correlation with the speed criterion for the Pennsylvania sample, this aptitude was not selected for further consideration because there was no other evidence of significance, qualitative or quantitative, for this aptitude. Aptitude F was not selected for further consideration because of the general lack of statistical evidence for this aptitude.

Various combinations of Aptitudes G, V, P, Q and K with appropriate cutting scores were selected as trial norms. The relationship between each set of trial norms and the criterion (dichotomized as indicated in section VII) was determined for each sample separately and for the combined sample. A comparison of the results showed that norms consisting of G-85, V-100, P-95 and Q-100 had better selective efficiency than any other set of norms tried.

In test development studies, an attempt is made to develop a set of norms such that the cutting score for each aptitude will be set at a five-point score level close to one standard deviation below the aptitude mean of the experimental sample. Adjustments of cutting scores from one standard deviation below the mean are made to effect better selective efficiency of the norms. In the case of this study the aptitude cutting scores are each within ten points of one standard deviation below the aptitude mean of the combined sample.

VII. Concurrent Validity of Norms

In order to compute tetrachoric correlation coefficients between the norms and the criterion for the two separate samples and for the combined sample, the criterion for each sample was dichotomized as follows:

A. Pennsylvania - Validation Sample: A multiple hurdle on speed and accuracy scores was used as the basis for forming the criterion dichotomy. In order to give speed and accuracy equal weights in the multiple hurdle criterion, the speed and accuracy cutting scores were each set at the same number of standard deviation units below the mean. The cutting score on each component was set at .68 standard deviation units below the criterion mean. The .68 value was chosen so that the obtained cutting scores, when applied to the data, would result in placing as close as possible to one third of the sample in the low criterion group.

B. Tennessee - Cross Validation Sample: The criterion was dichotomized so that one third of the sample would be placed in the low criterion group. This was accomplished by using 13 as the criterion cutting score.

Tables IV-A and IV-B show the relationship between test norms consisting of G-85, V-100, P-95 and Q-100 and the dichotomized criterion for the Pennsylvania sample and the Tennessee sample, respectively. Table IV-C, a composite of these two tables, shows the relationship between the test norms and the criterion for the combined sample. Workers in each low criterion group have been designated as "poor workers" and workers in each high criterion group have been designated as "good workers."

TABLE IV-A

Relationship between Test Norms Consisting of Aptitudes G, V, P and Q with Critical Scores of 85, 100, 95 and 100, Respectively, and the Dichotomized Criterion for the Validation Sample (Pennsylvania)

Proofreader I 209.688
N = 57

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	5	34	39
Poor Workers	8	10	18
Total	13	44	57

$r_{tet} = .59$ $\quad X^2 = 5.315$

$\sigma_{r_{tet}} = .24$ $\quad P/2 < .025$

The data in the above table indicate a significant relationship between the test norms and the criterion for the Validation Sample.

TABLE IV-B

Relationship between Test Norms Consisting of Aptitudes G, V, P and Q with Critical Scores of 85, 100, 95 and 100, Respectively, and the Dichotomized Criterion for the Cross Validation Sample (Tennessee)

Copy Holder 209.588
Proofreader 209.688

N = 48

Non-Qualifyi

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	13	19	32
Poor Workers	13	3	16
Total	26	22	48

$r_{tet} = .63$ $\quad X^2 = 5.549$

$\sigma_{r_{tet}} = .24$ $\quad P/2 < .01$

The data in the above table indicate a significant relationship between the test norms and the criterion for the Cross Validation Sample.

TABLE IV-C

Relationship between Test Norms Consisting of Aptitudes G, V, P and Q with Critical Scores of 85, 100, 95 and 100, Respectively, and the Dichotomized Criterion for the Combined Sample

Copy Holder 209.588.
Proofreader 209.688

N = 105

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	18	53	71
Poor Workers	21	13	34
Total	39	66	105

$r_{tet} = .55$ $\quad X^2 = 11.543$

$\sigma_{r_{tet}} = .16$

13 $P/2 < .0005$

The data in the above table indicate a significant relationship between the test norms and the criterion for the Combined Sample.

VIII. Conclusions

On the basis of mean scores, correlation coefficients, the job analysis data and their combined selective efficiency, Aptitudes G, V, P and Q with minimum scores of 85, 100, 95 and 100, respectively, are recommended as B-1002 norms for the occupations of Copy Holder 209.588, Proofreader 209.688

The equivalent B-1001 norms are G-90, V-100, P-95 and Q-100.

IX. Determination of Occupational Aptitude Pattern

When the specific test norms for an occupation include four aptitudes, only those occupational aptitude patterns which include three of the four aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. None of the existing 22 occupational aptitude patterns meet these requirements for this study. Therefore, none of the existing occupational aptitude patterns is recommended for the occupations covered by this study. However, the data for this sample will be considered for future groupings of occupations in the development of new occupational aptitude patterns.